FIELD MANUAL No. 3-15

HEADQUARTERS
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NUCLEAR ACCIDENT CONTAMINATION CONTROL

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Section I. INTRODUCTION

1. Purpose

This manual provides guidance for training, equipping, and utilizing alpha monitoring teams, to include the Alpha team and the Plutonium monitoring and decontamination (Plucon) team, for nuclear accident radiological contamination control.

2. Scope

a. This manual covers procedures and techniques in reducing radiation hazards resulting from nuclear accidents and the procedures applicable to initiating and sustaining control over movement in relatively small areas that contain hazardous levels of radiological contamination. It describes procedures and practices for detecting, identifying, measuring, controlling, and decontaminating radiological contamination; and specifies the levels of radiological contamination that are significant both during recovery operations and after decontamination at a nuclear accident site. FM 3–12 and TM 3–225 outline the procedures that are applicable to large areas of radiological contamination.

b. This manual is designed primarily for peacetime operations. It is also applicable to nonnuclear and nuclear warfare except that during warfare, alpha contamination is not considered militarily significant; however, if the situation permits, the procedures outlined herein should be followed.

3. Responsibilities

a. Command jurisdiction of a nuclear accident site is normally the responsibility of the commander of the army geographical area in which the accident occurs unless precluded by specific directive of the Department of Defense. Command is initially assumed by the commander of the military installation at or nearest the scene of the accident and is subsequently assumed by a designated Army Area Representative (AAR) upon his arrival at the site.

b. If an accident involves nuclear material in transit outside a military installation, the duly appointed courier officer initially assumes command at the site pending arrival of the commander of the nearest military installation or his representative. The designated AAR assumes responsibility upon his arrival.

c. Primary command responsibility for control of an accident rests with the service or agency having physical possession of the weapon at the time of the accident. However, if the accident is of a domestic emergency nature, primary command responsibility for control will rest with the Department of the Army (Joint Department of the Army, Navy, Air Force, and Atomic Energy Commission Agreement).

d. A Command SOP for nuclear accident/incident control should be prepared by units which are or may become involved with nuclear weapons. Appendix II may be used as a guide.

4. Changes

Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to the Commandant, U. S. Army Chemical School, Fort McClellan, Alabama 36205.

Section II. NUCLEAR ACCIDENT HAZARDS

5. General

a. A nuclear accident is an unexpected event involving a nuclear weapon, utilization facility, or component of either, resulting in any of the following situations:

(1) Loss of or serious damage to the weapon or component.

(2) Nuclear or nonnuclear explosion of the weapon or facility.

(3) Radioactive contamination.

(4) Public hazard.

b. Although nuclear weapons are designed to preclude a nuclear yield in the event of accidents, the high explosives and the radioactive fissionable material in themselves constitute a probable hazard. The precautions taken against these hazards are more than sufficient for the control of hazards from other components, such as explosive fuels.

6. Hazards

a. High Explosives. All nuclear weapons contain conventional high explosives. These high explosives constitute the major hazard involving nuclear weapons in an accident. An accident or fire that occurs during shipment or storage of a nuclear weapon must be treated in the same manner as an accident or fire that occurs during shipment or storage of conventional high explosives. See AR 95–55, TM 5–315, TM 9–1903, and TB 385–2.

b. Radioactive Fissionable Material.[1]

(1) *Plutonium.* Plutonium is a flammable metal which when first processed looks like stainless steel but which rapidly oxidizes to a characteristic brownish-black color. When associated with a fire or detonation of high explosives, plutonium burns easily and is pulverized into minute, invisible particles that are dispersed in smoke and dust and can cause contamination over a large area. Airborne suspensions of plutonium produced when an accident occurs may be resuspended by natural forces, such as the wind, or by vehicles or low-flying aircraft operating in the area. Particle air sampling is therefore necessary to properly evaluate the hazard caused by airborne radioactive particles. The plutonium referred to throughout this manual is plutonium-239. Plutonium-239 is an alpha radiation emitter.

(*a*) The primary hazard of plutonium is from inhalation of particles suspended in the air. Of 100 particles of plutonium oxide inhaled, 25 are exhaled immediately. Fifty are deposited in the upper respiratory tract and are swallowed or expectorated in several days. Of the 25 particles deposited in the lower respiratory tract, 15 are removed from the lungs at a rate governed by a 120-day biological half-life.[2] Ten are absorbed into the bloodstream. Seven of these are deposited in the skeletal system and may produce cancer or bone diseases many years later. In areas where 10,000 disintegrations per minute per cubic meter (dpm/m^3) airborne alpha contamination is encountered, some type of self-contained breathing apparatus should be worn by the initial entry team. If airborne alpha contamination is suspected but the concentration is unknown, the level of 10,000 dpm/m^3 should be assumed and a self-contained breathing apparatus worn until the hazard has been definitely established.

(*b*) A serious hazard of plutonium is from intake into the bloodstream through deep wounds, even though absorption into the circulatory system is slow. Hazards are partically negligible from absorption of plutonium on the skin and from intake through shallow wounds.

(2) *Uranium.* Uranium, when first processed, looks like stainless steel, but it

[1] For further information, see SECRET DASA Technical Letter 20–2.
[2] The time required for the body to eliminate one-half of an administeerd dose of any substance by regular process of elimination.

slowly oxides to a golden color and then to a characteristic blue-black or black color. Since uranium does not burn as easily as plutonium, there is less likelihood of a contaminated smoke hazard and greater likelihood that large pieces of metallic uranium will be scattered at the scene of an accident. The smaller pieces may burn, however, and cause some airborne hazard. Inhalation is the primary means of entry of uranium into the body. In cases of accidents involving uranium contamination, a 90-percent efficient respirator for 10-micron and large size particles will normally provide sufficient protection. In areas of maximum contamination, a situation may be encountered where a self-contained breathing apparatus (ABC–M15A1 or M20) would be required for sufficient protection. In this instance, the toxic hazard from heavy metal poisoning must also be considered. For advice on heavy metal poisoning, consult medical personnel.

(3) *Fission products.* Should a nuclear weapon or device involved in an accident actually result in a partial nuclear yield, there will be a beta-gamma hazard (fission products) as well as an alpha hazard from unfissioned uranium or plutonium. Beta particles do not constitute an external hazard due to their limited range and penetrating ability. However, they can produce surface burns and are a significant internal hazard. Conversely, the much greater range and penetrating ability of gamma radiation present an important external hazard, and its presence or absence must be determined. Should the accident occur in a closed area such as inside a building or in an underground structure, vapor concentrations of toxic materials may result and will remain a hazard until aeration and decontamination are accomplished. These toxic materials will be radioactive and will contaminate the interior of a closed area.

7. Significant Levels of Contamination

The significant hazardous levels of radiological contamination that have been established for a nuclear accident are as follows:

a. Beta-gamma radiation—10 millirad per hour (10 mrad/hr).

b. Alpha radiation—1,000 micrograms of plutonium-239 per square meter (1,000 μg Pu^{239}/m^2). However, any concentration higher than 10 micrograms of plutonium-239 per square meter for alpha radiation may produce a serious resuspension problem. Plutonium-239 is assumed in all cases of alpha contamination because it constiutes the greater hazard.

8. Protective Measures

a. If alpha contamination is suspected, respirators, protective masks, or, if necessary, self-contained breathing apparatuses will be worn in approaching the accident site. The site should be approached from upwind, and visible concentrations of dust or smoke should be avoided.

b. Eating, drinking, and smoking will not be permitted in the contaminated area. Cigarettes and foodstuff will not be carried into the contaminated area.

c. Care should be taken to avoid cuts or breaks in the skin.

d. Military uniforms, civilian clothing, or any garments that cover the body are suitable for contamination control operations. Disposable items such as coveralls, gloves, and boot covers should be worn to facilitate personnel decontamination.

Section III. ALPHA TEAM

9. Alpha Team

An Alpha team is a CBR team as organized in CONUS with an additional capability and responsibility for alpha monitoring. As used in this manual, Alpha team will be understood to refer to these special CBR teams with an alpha monitoring capability.

10. Mission

The mission of the Alpha team is to—

a. Detect and identify radiological contamination resulting from an accident.

b. Report the presence of radiological contamination immediately upon detection to the AAR or, in his absence, to the senior officer present. Request that a Plucon team (sec. IV) be called if any alpha or if significant beta-gamma contamination is detected.

c. Mark the 1,000 μg Pu^{239}/m^2 contour line if alpha radiation is detected.

d. Mark the 10 mrad/hr contour line if beta-gamma radiation is detected.

e. Mark the exclusion perimeter. If both alpha and gamma radiation are detected, the exclusion perimeter may be a combination of contours as determined in *c* and *d* above, using the contour farthest from zero point of the accident.

f. Provide security for any nuclear weapon components if the team is first to arrive at a nuclear accident site.

g. Perform other duties as assigned by the AAR.

11. Organization

The Alpha team should consist of a minimum of one officer and four enlisted men, all qualified in the detection, identification, and measurement of radioactivity and having a general knowledge of the decontamination and health physics aspects of radioactivity. At least two of the enlisted men should be qualified driver/radio operators. Two monitors per Alpha team are a minimum requirement since monitoring, recording (to include immediate radio communicating), and marking will be performed.

a. The team leader will coordinate the activities of the Alpha team with those of other emergency teams at the accident site and furnish advice on radiological monitoring and survey procedures and emergency decontamination measures for personnel (pending arrival of the Plucon team).

b. All monitors will be qualified to perform alpha, beta, and gamma radiation monitoring.

c. All team members will have a minimum security clearance of Secret.

12. Equipment

See section V.

13. Training

See section VI.

14. Utilization

a. A minimum of one Alpha team will be organized in each ZI army area of responsibility. During each movement involving a complete nuclear weapon, an Alpha team will be on standby in the army area of responsibility. The most expeditious mode of transportation will be immediately available to move the team to an accident site. After notification of a nuclear accident, this team should be able to depart a local assembly area, prepared to perform its mission, within 30 minutes during duty hours and within 1 hour during off-duty hours. As teams are committed to accident sites, they will be replaced by other teams on alert status so that additional teams may be committed to the nuclear accident site, if necessary, or may provide support in case of another nuclear accident.

b. After reporting at the accident site, the team will coordinate with other emergency teams present. In the event the Alpha team is the first to arrive at the accident site, the team leader will assume the responsibility of directing emergency actions until properly relieved. If radiological contamination is detected, the contaminated area will be marked and controlled; a Plucon team will be requested through the AAR. The Alpha team will remain at the site to furnish advice and special assistance to the AAR. Upon arrival of the Plucon team, the Alpha team, if directed by the AAR, will assist the Plucon team.

c. After coordination with other emergency teams, the Alpha team will monitor for radiological contamination. Detection of any radiation above normal background will be reported immediately. The Alpha team will then conspicuously mark and record the location of the 10 mrad/hr beta-gamma contour line and/or the 1,000 μg Pu^{239} m^2 level for alpha contamination. Unit conversion factors necessary in evaluating alpha contaminantion are contained in section VII. Engineer tape, supported by stakes and posted with contamination markers

(fig. 1), should be used to mark the contaminated area.

d. The Alpha team or other teams as designated by the AAR must ascertain the names and locations of all individuals and the identity of any animals that were in the immediate vicinity of the accident for possible legal and medical reasons. All these people and animals should be monitored, decontaminated if necessary, and referred to the Plucon team or the Radiological Emergency Medical Team for further tests.

e. Relationships with news media personnel will be as prescribed in AR 360-5.

Section IV. PLUTONIUM MONITORING AND DECONTAMINATION (PLUCON) TEAM

15. General

A Plucon team is a special radiological team that is organized to provide technical assistance and advice to the AAR in radiological emergencies.

16. Mission

The mission of the Plucon team is to—

a. Perform a detailed alpha and beta-gamma radiological survey.

b. Control and contain the radiological contamination at an accident site.

c. Provide assistance, if required, to explosive ordnance disposal (EOD) team(s) in the reclamation of radioactive materials when such radioactive material is a nuclear weapon or weapon components.

d. Supervise waste disposal measures (sec. IX).

e. Determine the requirements for decontamination and provide technical advice for decontamination operations.

f. Provide technical advice on radiological aspects of the accident.

g. Provide health physics and radiological safety services.

17. Organization

The Plucon team will consist of a minimum of a team leader and eight other individuals qualified to perform the duties specified below:

a. The team leader will coordinate actions with other emergency teams at the accident site. He should be a Nuclear Weapons Effects Officer (MOS 7330).

b. The assistant team leader will perform the duties of the team leader in his absence and other duties as assigned.

c. A radiological safety technician will supervise the air and ground monitoring activities of the team and advise on all radiological safety requirements, including dosimetry aspects.

d. Two monitors will perform radiological monitoring and sampling activities, which may include mathematical unit conversions.

e. A decontamination specialist will advise on and supervise all aspects of radiological decontamination of personnel, equipment, and facilities.

f. A laboratory technican will perform radiochemistry laboratory procedures, including quantitative alpha determinations.

g. An instrument technician will calibrate, check, maintain, and repair air samplers and radiacmeters, as required.

h. An administrative assistant will maintain the necessary reports, records, operational logs, contamination maps, and files.

18. Equipment

See section V.

19. Training

See section VI.

20. Utilization

a. If a nuclear accident occurs, a Plucon team will be immediately placed on an alert status by the commander having control over the Plucon team. If any alpha or significant beta-gamma contamination is involved, the services of a Plucon team will be requested by fastest communication and operational immediate precedence. Within CONUS, Plucon teams are available upon request of the AAR by teletype to Commander, U. S. Army Nuclear Defense Laboratory, Edgewood Arsenal, Maryland, or by telephone to U. S. Army Nuclear Defense Laboratory, Area Code 301, 676-1000, extensions 26248 or 23121 during duty hours

(0745 to 1615 hours Eastern Time) or extensions 22203 or 21137 during off-duty hours.

b. Upon receipt of a movement order, the Plucon team will be en route within 4 hours. The team will travel by air or surface transportation, whichever provides the most expeditious means. If the entire team cannot be en route within 4 hours, an advance party consisting of a minimum of the team leader and one monitor will be en route within 4 hours. The remainder of the team, under the command of the assistant team leader, will proceed as soon as possible after the advance party so as to arrive within 24 hours after receipt of the movement order.

c. Upon arrival at the accident site, the team leader will report to the AAR for instructions, and the team will determine the degree and extent of radiological contamination. The team will secure the names of all individuals and ascertain the identity of any animals involved in the accident and determine their present location. Decontamination of personnel, animals, and equipment will be accomplished within physical limitations. Cleanup and contamination control measures taken by augmentation personnel with equipment obtained from adjacent military installations will be supervised by the Plucon team. The Alpha team will provide additional specialist assistance. Section IX contains decontamination details.

SECTION V. SUGGESTED EQUIPMENT FOR ALPHA AND PLUCON TEAMS[1]

Item No.	Item	Quantity	
		Alpha team	Plucon team
	A. DETECTION AND IDENTIFICATION EQUIPMENT		
1	Radiac set AN/PDR-60[2]	4	5
2	Radiac set AN/PDR-27J	4	4
3	Gamma radiacmeter IM-174/PD	2	4
4	Tritium monitor (Atomic Model TSM-91-B or equivalent)	----------	1
5	Repair parts and extra batteries for radiacmeters	As required	As required
6	Air sampler, high-volume, 24v, dc, with filter holder and filters (example: TF1A-4 Staplex).	----------	4
7	Air sampler, high-volume, 110v, ac, with filter holders and filters (example: TF1A-27 Staplex).	----------	6
8	Tripod mounts for air samplers	----------	8
9	Anemometer, ML-433/PM (FSN 6660-663-8090)	----------	1
	B. DOSIMETRY AND HEALTH PHYSICS EQUIPMENT		
10	Pocket dosimeter, IM-9( )/PD[3] (0-200 mrad)	2 per mbr	2 per mbr
11	Pocket dosimeter, IM-147/PD[3] (0-50 rad)	2 per mbr	2 per mbr
12	Pocket dosimeter, IM-93/UD[3] (0-600 rad)	2 per mbr	2 per mbr
13	Radiac detector charger PP-1578A/PD	2	2
14	Film badges (beta-gamma)	1 per mbr	2 per mbr
15	Replacement film for film badges	----------	As required
16	Nose and surface swipes, kit:[4]	1	1
	Swabs, chemical agents sampling, type 1, FSN 6665-170-5499 — 1,000 ea.		
	Paper swipes, nose, w/stick — 1,000 ea.		
	Applicator, wood, cotton-tip (1/12 in. x 6 in.), FSN 6165-303-8250 — 1,000 ea.		
	Test tube, 10 ml (for use with cotton and paper swipes) — 50 ea.		
	Plastic envelope, ½ in. x 3 in. (for use with cotton and paper swipes) — 1,000 ea.		
	Paper separators (each holds 10 papers for surface swipes) — 1,000 ea.		

See footnotes at end of table.

Item No.	Item	Quantity	
		Alpha team	Plucon team
17	Soil sampling equipment, kit: Broom, whisk, straw, 8 in., FSN 7920–292–4364 2 ea. Knife, putty, 1 in. x 6 in. 2 ea. Bottle, wide-mouth, screw cap, 210 ml, FSN 8125–408–9125 20 ea.	----------	1
18	Water testing kit, poisons, M4A1 (Use sampling portion of kit. See TB CML 79 for components.)	----------	1
19	Replacement parts for sampling equipment kit	----------	1
	C. COMMUNICATIONS EQUIPMENT [5]		
20	AN/PRC–6 radio (or similar type)	3	4
21	Spare batteries	As required	As required
	D. ELECTRONIC REPAIR EQUIPMENT		
22	Tool kit, electronic repair	----------	1
23	Meter, volt-ohm	----------	1
24	Repair parts, electronic equipment, kit	----------	1
	E. MARKING EQUIPMENT		
25	Engineer tape, ¾ in. wide, ft.	5,000	3,000
26	Stakes (for markers)	50	100
27	Radiation hazard marking signs	As required	As required
28	Grease pencils, assorted colors	As required	As required
	F. DECONTAMINATION EQUIPMENT		
29	Personnel decontamination kit (soap, towels, brushes, brooms, etc.)	1 per mbr	1 per mbr
	G. PROTECTIVE EQUIPMENT		
30	Boot covers, cloth or plastic, pr	1 per mbr	3 per mbr
31	Coveralls, cloth or plastic, pr	2 per mbr	3 per mbr
32	Gloves, cloth or canvas, pr	2 per mbr	3 per mbr
33	Gloves, rubber, pr	1 per mbr	3 per mbr
34	Surgeon's cap	2 per mbr	3 per mbr
35	Protective mask, M17 (or similar type)	1 per mbr	2 per mbr
36	Masking tape, 3-in., rolls	4	4
37	Breathing apparatus self-contained, M20 (MSA or equivalent)	----------	2
	H. INDIVIDUAL EQUIPMENT [6]		
38	First-aid packet, individual	1 per mbr	1 per mbr
39	Lensatic compass	2	4
40	Canteen	1 per mbr	1 per mbr
41	Pistol belt	1 per mbr	1 per mbr
42	Poncho (or raingear)	1 per mbr	1 per mbr
43	Clipboard	2	8
44	Flashlight, w/batteries	1 per mbr	1 per mbr
45	Entrenching tool	1 per mbr	1 per mbr
	I. ADMINISTRATIVE EQUIPMENT AND SUPPLIES [7]		
46	Notebook	2	2
47	Road maps of areas of responsibility	2	2
48	Paper, pencils, blank forms, maps, acetate, press release forms	As required	As required

See footnotes at end of table.

Item No.	Item	Quantity	
		Alpha team	Plucon team
	J. MISCELLANEOUS EQUIPMENT		
49	Plastic bags, large	10	100
50	Plastic bags, medium	10	100
51	Plastic bags, small	----------	100
52	Footlockers	As required	As required

[1] Based on team strengths cited in this manual.
[2] IM–156 ( )/PD will be replaced by Alpha Radiacmeter IM–170/PD (radiac set AN/PDR–60) with plutonium gama probe as the latter becomes available for issue.
[3] The Plucon team should have at least 10 extra dosimeters of each type for use of the AAR, VIP's, fire fighters, and others.
[4] Cotton-tipped swabs or beta-gamma emitters; paper for alpha emitters. Kits may be fabricated locally; components may be procured from commercial sources.
[5] Depending upon local situations and conditions, the team mission may be expedited by the addition of one AN/VRC–8 radio (or similar type) per Alpha or Plucon team.
[6] Personal clothing and sundry requirements should support team members for 1 week without resupply. Individual and unit clothing and equipment cited herein are for technical mission use. Clothing should be adequate for the terrain and weather in which the teams are employed.
[7] Toll tickets and POL credit cards are recommended also when and where feasible.

Section VI. RECOMMENDED TRAINING PROGRAM FOR ALPHA AND PLUCON TEAMS

21. General

The training program recommended is based on the assumption that each member of a team has received individual training at the appropriate service school; therefore, the program is designed to train the members to function as a team. This training should be conducted in conjunction with the training of other emergency teams.

22. Plucon Team

a. All members will be trained in alpha and beta-gamma monitoring.

b. Training to qualify individual team members in their assigned functions will be conducted periodically to insure availability and proficiency.

23. Alpha Team

In addition to the CBR training program, an alpha monitoring course consisting of a minimum of 5 hours will be presented to designated Alpha teams. This course is outlined below.

Period	Hours	Subject	Scope	References
1	1	Orientation.	Description of nuclear accident control plan (NAICP) in army basic plan concerned.	NAICP of pertinent army basic plan.
2	1	Procedures and Protection, Hazards of Alpha Radiation.	Procedures and problems concerning alpha radiation. Protection against hazards. Basic science of alpha radiation.	TM 11–6665–207–12; TM 3–225; Eberline Manual for Radiacmeter PAC–1SA.
3	1	Alpha Survey Meters and Survey Techniques.	Familiarization with standard alpha instruments. Characteristics, controls, operation, and nomenclature.	Do.
4	1	Standard Alpha Instrument Maintenance and Calibration.	Use, functioning, maintenance, and calibration of the instrument.	Do.
5	1	Procedures and Protection for Alpha Monitoring.	Procedures and problems concerning the monitoring of alpha radiation. Techniques of alpha monitoring. Protection against hazards; protective clothing and equipment.	Do.

24. Test Alerts

To determine that individuals are adequately trained in all operational phases, periodic test alerts are required. See ZI Army Nuclear Accident/Incident Control Plan (NAICP) for details.

Section VII. ALPHA MONITORING TECHNIQUES

25. General

a. The alpha particle is a relatively large, doubly positive charged, highly ionizing nuclear particle with a short range in matter. Alpha particles are always emitted with difinite discrete energies from a parent nucleus. Plutonium-239 emits a 5.15 Mev alpha particle which travels about 4 centimeters in air. An alpha particle is, by nature, a helium nucleus. Because of their large mass, alpha particles travel in a straight path and are emitted in all directions from their source. Energy is lost by collisions with air molecules. With their energy expended, forward progress stops. Two free electrons are attracted by the double positive charge and a helium atom is formed. The alpha particle is no longer detectable.

b. The principal alpha emitters contained in nuclear weapons are uranium (U^{235}, U^{238}) and plutonium (Pu^{239}). Plutonium is the more dangerous because it is the greater internal hazard; all easily become airborne and can be inhaled. To safeside, all measurements of alpha contamination will be considered in terms of plutonium-239.

c. The maximum range in air of alpha particles depends on their energy. Under standard conditions, the maximum range in air of alpha particles from Pu^{239} is 4 centimeters. Liquids, such as water, and solids, such as paper or animal tissue, will reduce this range by a factor of about a thousand. For example, a Pu^{239} alpha particle will penetrate about 0.004 centimeter of paper.

d. Considering all these facts, it is readily apparent that alpha contamination may be exceedingly difficult to detect under some conditions even though the detecting instrument works perfectly. Additional factors concerning actual monitoring are discussed in paragraph 27*b*(1).

26. Alpha Radiacmeters

a. The detecting chamber in alpha instruments is basically the same as that used in any radiac instrument, except that one side is covered by a very thin mylar film that allows alpha particles to enter the chamber.

b. The following instruments are the standard alpha radiac sets:

(1) *IM–156( )/PD (JUNO SRJ–6).* This ion chamber instrument will detect alpha, beta, gamma, and X-ray radiation, but it has been procured for the purpose of detecting and measuring plutonium-239. This radiacmeter will normally be used for detecting alpha radiation. For detailed information, see TM 11–6665–207–12. (Since this technical manual was issued, the AN/PDR–53 set has been canceled as a set. However, the components, the IM–156( )/PD radiacmeter and the TS–1230( )/PD calibrator, are presently standard-C items.)

(2) *AN/PDR–54 (IM–154/PD) (EBERLINE PAC–3G).* This proportional instrument is capable of measuring only alpha radiation. For detailed information, see TM 11–6665–208–15. It is a standard-C alpha survey radiacmeter.

(3) *AN/PDR–60 (IM–170/PD) (EBERLINE POC–1SA).* This instrument uses a zinc sulfide silver-activated scintillator for measuring alpha in the presence of limited beta and gamma radiation. See Technical Manual for Scintillation Alpha Counter: Model PAC–1SA, published by Eberline Instrument Corporation, Santa Fe, New Mexico. It is the standard-A alpha survey meter.

27. Monitoring Procedures

a. Beta-Gamma. The monitor should check for the presence of beta-gamma radiation prior to monitoring for alpha radiation. The following instruments are the standard beta-gamma survey radiac sets:

(1) *IM–174/PD.* This ion chamber instrument measures high dose rates of gamma radiation only. For detailed instructions, see TM 11–6665–213–12.

(2) *AN/PDR–27J (IM–141).* This Geiger-Mueller instrument is capable of measuring low dose rates of gamma and of detecting beta radiation. For detailed instructions, see TM 11–6665–209–15.

b. Alpha. Several factors are to be considered when using alpha radiacmeters.

(1) *General.* Alpha radiation is a very difficult type of radiation to measure. This is due almost entirely to the very short range of the emitted alpha particles. Except in the case of very high dose rates, alpha instruments must be placed within 4 centimeters of the contaminated surface before the instrument will detect any alpha radiation. This makes alpha monitoring a very slow, tedious, and physically tiring process. The range is decreased considerably by liquids or solids. A wet surface, resulting from rain, dew on the ground, or from fire fighting (a distinct possibility at a nuclear accident site), cannot be monitored successfully. Heavy dust conditions can prevent a correct reading by dust settling over the contaminated area. The surface itself must be considered. On a rough surface such as plowed ground, clothing, or rough concrete, the alpha contamination settles in depressions and crevices in the surface. The alpha particles subsequently emitted are shielded by the surface itself and cannot be detected by an instrument no matter how close the instrument is to the surface. Correction factors for various surfaces have been obtained from tests and are discussed in paragraph 28. In addition to the above considerations, it is necessary to have a very thin window over the detector of a radiacmeter in order for alpha particles to enter the chamber and be detected. These windows are very fragile and extreme care must be taken to prevent puncturing when placing the probe near or on the ground.

(2) *Meter reading interpretation.*

(*a*) To take a reading, the probe should be placed in contact with the surface being monitored.

Caution: **The probe face is very thin and extremely fragile. Set the probe down very gently and do not place it down on any sharp object, such as grass stubble or rocks, which might puncture the thin window.**

Placing the probe on the surface insures consistent results even though the probe face might become contaminated. In most applications any contamination will be a small percentage of the total reading and can either be neglected or subtracted from the succeeding surface readings. If the probe contamination reading is large compared to the surface reading, the probe must be decontaminated. A damp cloth wiped very gently across the probe face or the use of a soft brush will reduce the contamination considerably in most cases. For further details see paragraph 47*e*(2)(*c*). On dry powdery surfaces where large amounts of probe contamination would result if the probe touched the ground, a 1/8-inch block may be taped to each end of the probe. This will insure a constant probe height above the ground when readings are taken. However, the instrument must be recalibrated with the blocks in place or a correction otherwise made.

(*b*) To obtain a representative reading for a particular point, several readings should be taken on and around the point. After each of these readings the probe should be lifted off the ground and the meter checked to see if any contamination resulted. If so the contamination reading may be subtracted from the succeeding reading. Record the highest of these corrected readings as the reading for the point in question.

(*c*) An accuracy figure for any alpha radiacmeter cannot be specified because any measurement will vary considerably, depending on the energy of the emitted alpha particle and the type of surface being monitored. If more than one type of surface is being monitored, the surface type and condition should be included with the meter reading from that point.

28. Conversion of Units

a. Measuring alpha particles from an alpha source gives an indication of the amount of contamination on the ground. The amount of contamination is the important unit because this will determine the degree of decontamination required and will give an indication of the airborne concentration of the alpha emitter. Thus, the unit finally concerned with is the weight of alpha emitter per unit area. In this case the unit is micrograms of plutonium-239 per square meter ($\mu g\ Pu^{239}/m^2$). To convert from the radiacmeter reading to $\mu g\ Pu^{239}/m^2$, the following formula is used:

$$\mu g\ Pu^{239}/m^2 = \frac{R \times E \times 10^4}{1.4 \times 10^5 \times A} = \frac{R \times E}{14 \times A},$$

(Equation 1)

where, R = radiacmeter reading (mrad/hr or cpm),

E = factor to convert mrad/hr or cpm to dpm (disintegrations per minute),

A = area of probe in cm^2,

10^4 = factor to convert cm^2 to m^2, and

1.4×10^5 = specific activity of Pu^{239} (dpm/μg).

The values of E and A are given for each standard radiacmeter in table I.

Table I. Values of E and A for Standard Alpha Radiacmeters.

Instrument	Efficiency factor	Probe area (cm^2)
IM-710/PD (AN/PDR-60)	2	59
IM-154/PD (AN/PDR-54)	2	61
IM-156/PD	5,680	91

b. Equation 1 is derived with the assumption that there will be no sample self-absorption or surface absorption of alpha particles. Because of these assumptions, the equation is good only for very smooth surfaces such as glass with the contamination evenly divided over the surface. This situation very seldom occurs in field situations. Equation 1 can be modified for field use by combining the constant factors (E and A) in equation 1 and a surface factor into one overall correction factor. Then:

$$\mu g\ Pu^{239}/m^2 = R\ (CF), \qquad \text{(Equation 2)}$$

where, R = meter reading (cpm or mrad/hr) and

CF = correction factor to convert meter readings into $\mu g\ Pu^{239}/m^2$.

Factors for some common surfaces are given in table II.

Table II. Correction Factors for Some Common Surfaces.

Instrument	Correction factor (from meter reading to $\mu g\ Pu^{239}/m^2$)			
	Concrete	Soil	Plywood	Smooth[1]
IM-170 (AN/PDR-60)	1/200	1/170	1/240	1/400
IM-154 (AN/UDR-54)[2]	1/200	1/170	1/240	1/400
IM-156/PD	7	8	6	5

[1] Calculated from equation 1 and safesided.

[2] If either the X20 or X100 shield is used, multiply the answers obtained by 20 or 100 respectively.

If the surface being monitored is not listed in table II, use the factor for the surface which most nearly approximates the surface being monitored. Occasionally very rough surfaces will be encountered for which none of the factors in table II is appropriate. For example, when monitoring on plowed ground with the IM-170/PD radiacmeter the factor used is approximately 1/8. A reading of 80,000 cpm obtained on plowed ground is equivalent to approximately 10,000 $\mu g\ Pu^{239}/m^2$. In cases where no appropriate correction factors can be deter-

mined, record the meter readings and consult with the Plucon team leader upon his arrival.

c. Table III gives the converted meter readings for all the standard alpha instruments. This table gives the monitor a quick reference for field use in converting meter readings to $\mu g\ Pu^{239}/m^2$. The readings given are for smooth surfaces only.

Table III. Converted Readings for Smooth Surfaces.

Meter reading		Contamination level
(cpm)	(mrad/hr)	($\mu g\ Pu^{239}/m^2$)
20,000	10	50
40,000	20	100
60,000	30	150
80,000	40	200
100,000	50	250
200,000	100	500
300,000	150	750
400,000	200	1,000
600,000	300	1,500
800,000	400	2,000
1,000,000	500	2,500
1,200,000	600	3,000
1,400,000	700	3,500
2,000,000	1,000	5,000
--------	5,000	25,000

29. Air Monitoring

a. Inhalation is the principal means by which alpha emitters enter the body. The amount of alpha emitters deposited in the body depends largely on their concentration in the air which is inhaled, the particle size, and the length of time the individual is exposed. In a restricted area, the maximum permissible air concentration for plutonium-239 has been established as 4×10^{-11} microcuries per cubic centimeter ($\mu c/cc$) for a 40 hour/week exposure and 1×10^{-11} $\mu c/cc$ for a 168 hour/week exposure. For unrestricted areas, 1×10^{-12} $\mu c/cc$ is the maximum permissible air concentration. To determine the concentrations present at or near the accident site, air samples must be collected and analyzed.

b. In a nuclear accident that result in large-scale air contamination, the particulate matter will probably have been deposited on the ground or dispersed before air sampling can be initiated. The problem in most cases is one of determining the hazard due to resuspension of the contaminants that are already on the ground.

c. Air monitoring includes the collecting of particles suspended in the air (sampling), measuring the radioactivity of the collected sample (analysis), and calculating the amount of radioactive material per unit volume of air.

30. Air Sampling

Air sampling may be performed to determine the airborne contamination at a specific location and time or to determine the contamination in an area over a period of time. The samples are divided into two principal types, based on the length of time involved in the collection.

a. *Spot Sample.* A spot sample is usually taken for a period of less than 10 minutes, and when analyzed, indicates the airborne contamination at a precise location at a given time.

b. *Continuous Sample.* A continuous sample is taken over a measured period of time, usually 2 hours or more, and indicates the average conditions in the sampled area over the period of time during which the sample was taken. This type of air sample will represent the conditions under which individuals may have been exposed.

31. Air Sampling Equipment

a. There are a number of different methods for obtaining a continuous air sample; among them are filtration, impaction, impingement, and electrostatic precipitation. Trays that have been surfaced with an adhesive may be used as collectors to make a qualitative check of airborne particles or to detect resuspension and spread of the contamination.

b. Filtration is the most practical air sampling method at a nuclear accident site. Special situations may require the use of other methods enumerated. Devices that utilize filter papers are described below:

(1) The Staplex high-volume air sampler is an example of a vacuum-type apparatus used to draw large volumes of air through a high efficiency filter paper. The efficiency of any sampler is ultimately determined by the type of filter material used. Collection and detection of an alpha emitter require a tight weave, fine grade filter paper such as Staplex Model TFA–66. The

flow rate of the sample will be determined by the apparatus and filter paper used. The Staplex-High Volume Air Sampler, Model TF1A–27, requires 110-volt, 60-cycle alternating current. Model TF1A–4 requires 24-volt direct current.

(2) There are a variety of other electrically operated air samplers that may be used; even an ordinary home vacuum cleaner can be used if the flow rate is calibrated.

32. Air Sampling Procedures

a. Location. Samplers will be located so that the extent and amount of airborne contamination can be determined both downwind and at the accident site.

b. Rate. Any sampling rate may be used as long as it is known along with the collecting efficiency of the sampling apparatus. The manufacturer's rated flow rate may be used; however, to assure accuracy, the sampler equipped with the type filter being used should be calibrated at the accident site. Samplers calibrated at sea level must be recalibrated at higher altitudes because of the lower air density.

c. Period. The length of sampling time will depend on the flow rate, amount of airborne dust that may cause filter clogging, and the volume required to detect maximum permissible concentrations. Samples of 100 to 1,000 cubic meters are necessary to obtain results within ±10 percent of true concentrations.

d. Recording Data. The following data should always be recorded for air samples:

(1) Location of sampler.
(2) Average flow rate.
(3) Total sampling time.
(4) Type of sampler.
(5) Size and type of filter paper.
(6) Type of radioactive material, if known.
(7) Wind and weather conditions.
(8) Operations being performed in the area during the sampling period.
(9) Any other pertinent data.

33. Analysis of Air Sampling Data

a. Evaluation of a radioactive aerosol is accomplished by measuring the radioactivity of the sample collected with either a portable radiac device or a laboratory counting system. For an accurate determination, laboratory counting is required. If a heavy layer of dust is collected on the filter, absorption of the alpha radiation by the soil may preclude accurate counting of the sample. A shorter sampling time will result in a reduced dust load on the filter paper and allow a direct count of the sample.

b. The background count for air samples may range from 10^{-9} $\mu c/cc$ to 10^{-11} $\mu c/cc$. This background count is due primarily to the spontaneous decay of uranium and thorium minerals in the earth's crust. There are three methods that may be used to correct for this background count:

(1) *Multiple samples.* Simultaneous samples are taken outside and inside the contaminated area. The outside sample is used for background correction and indicates the extent to which decay products interfere with the determination of long half-life alpha emitters. For details see TM 3–260.

(2) *Decay compensation.* The radon daughters, whose longest half-life is 30 minutes, may be considered completely decayed 4 hours after completion of sampling. The thoron daughters, whose longest half-life is 10.6 hours, will not decay to negligible proportions before about 72 hours. However, the decay of thoron may be estimated by taking two counts, one 4 hours after sampling and another at least 24 hours after sampling. The activity due to long half-life alpha emitters may be computed from the two counts by use of the following formula:

$$C_{LL} = \frac{C_2 - C_1 e^{-\lambda\Delta t}}{1 - e^{-\lambda\Delta t}},$$

where, C_{LL} = counts due to long-lived isotopes (cpm),
C_1 = counts resulting from first count (less background of counter) (cpm),

C_2 = counts resulting from second count (less background of counter) (cpm),

λ = decay factor (for thoron, $\lambda = 0.0655$),

Δt = time between counts, and

e = base of natural logarithms (2.7183).

(3) *Shielded samples.* A rough indication as to the activity of long half-life alpha emitters may be obtained by counting the contamination on the filter paper and then placing the filter paper in a glassine envelope, which the alpha radiation will not penetrate, and taking a second count. The radon and thoron activity will be reduced to about 30 percent by the glassine envelope; thus,

(*a*) If the second reading is about 30 percent of the first, the majority of activity is due to radon and thoron.

(*b*) If the second reading is less than 30 percent of the first, long half-life emitters may be present in significant concentration.

(*c*) If the second reading is nearly zero, the majority of the activity is due to long half-life emitters.

34. Calculation of Air Concentrations of Contamination

a. Calculations of air concentrations of alpha-contaminated aerosols are normally reported in μc/cc. To evaluate the activity, the following data are necessary:

(1) Total activity (cpm).

(2) Background activity (cpm).

(3) Total volume of air passed through the filter (m^3).

(4) Fraction of filter area counted.

(5) Efficiency of filter.

(6) Fraction of activity not self-absorbed.

(7) Counting efficiency of the instrument used.

(8) Conversion factor for dpm/m^3 to μc/cc (as used in this equation is 2.2×10^{12}).

b. To convert the activity to μc/cc, apply the data from *a* above as follows:

$$\text{Activity } (\mu c/cc) = \frac{(1) - (2)}{(3)\,(4)\,(5)\,(6)\,(7)\,(8)}$$

If the concentration of long-lived (C_{LL}) alpha emitters is determined by the method in paragraph 33*b*(2), the value of C_{LL} is used in place of (1) − (2) in the numerator above. For details, see TM 3–260.

35. Water Sampling

Water sampling involves collecting a representative volume of water (100 to 1,000 cc) and sending it to a laboratory for measurement of the radioactivity of the collected sample and calculation of the amount of radioactive material per unit volume of water. The primary precaution to observe in collecting and handling water samples is to prevent contamination of the samples.

a. Equipment. The only item required for water sampling is a container in which to collect and ship the sample. This container can be glass, plastic, or metal. See TB CML 79 for water sampling components of the M4A1 water testing kit.

b. Collection Procedures. If the sample is taken from surface water, it should be taken away from the edge of a pond or stream to avoid debris and to obtain a representative sample. If the sample is to be taken from a faucet, water should be allowed to run a short time before the sample is taken.

36. Analysis of Water Samples

There is no portable radiac instrument capable of detecting alpha contamination in water. This must be done by appropriate laboratory analysis. A reading above background on the IM–141/PD (AN/PDR–27J) indicates a concentration of an unidentified beta-gamma emitter in excess of 10^{-3} μc/cc. Since the maximum permissible concentration of an unidentified radionuclide in water is 10^{-7} μc/cc, the IM–141/PD cannot be used to determine concentrations in the range 10^{-7} to 10^{-3} μc/cc unless the water is evaporated from the sample before measurements are made. Since such evaporation in the field would be most difficult, water samples should also be checked for beta-gamma contamination by appropriate laboratory analysis. As a general procedure, water samples should be checked with the IM–141/PD radiacmeter.

37. Performance of Air and Water Sampling

Air sampling and water sampling are performed by the Plucon team since the Alpha team does not have the necessary equipment.

Section VIII. SURVEY TECHNIQUES

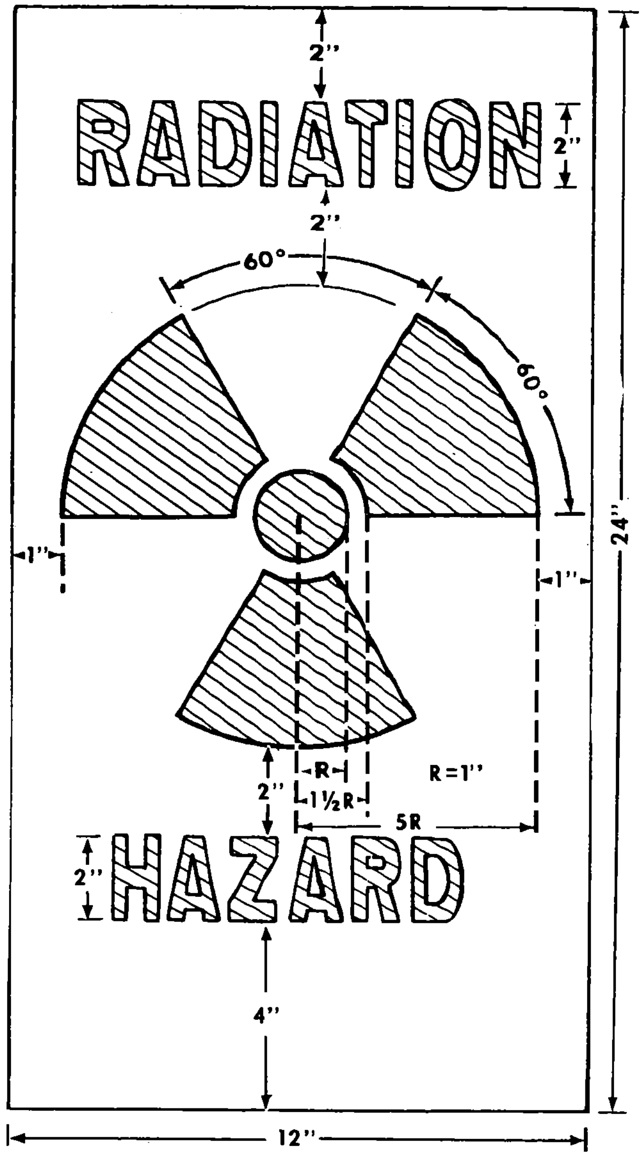
38. General

Upon notification of a nuclear accident, the Alpha team will proceed to the accident site as quickly as possible. If an EOD team arrives at the site first, its knowledge of the type of weapon involved and its preliminary radiological estimate of the situation will be available to the Alpha team. If the Alpha team is the first to arrive, the team leader will assume temporary command of the site, establish the area to be controlled (par. 51*a*) and insure security of any classified weapons components (operating parts will be moved only by personnel of the EOD team). An immediate survey will be conducted, starting upwind of the site, to determine possible presence of significant levels of hazardous contamination.

39. Alpha Team Survey

a. The monitors may be moved by vehicle to approximately 550 meters upwind from the accident site, where they will dismount and proceed on foot. This distance, 550 meters, is the minimum safe explosive distance; however, two additional factors must be considered. First, fragments flying from a high-order detonation may extend farther than 550 meters. Second, preliminary investigation may reveal that radioactive contamination hazards extend beyond a 550-meter radius. The monitors will be provided with equipment necessary to monitor for beta-gamma and alpha radiation and to mark the contaminated area. Figure 1 shows the approved Atomic Energy Commission radiological hazard marker which must be used in connection with nuclear accidents within CONUS. Avoid using radios in the accident area until the EOD team has determined the weapon condition because radio waves may be of sufficient energy to trigger a weapon involved in an accident.

b. The monitors will initially use the isodose rate method shown in figure 3, to delineate the contaminated area. If readings of 10 mrad/hr for beta-gamma or 1,000 μg Pu^{239}/m^2 are detected, the monitors will report the location. The monitors will then proceed in a clockwise manner, using the isodose rate procedure, and mark the 10 mrad/hr line for beta-gamma or the 1,000 μg Pu^{239}/m^2 line for alpha with engineer tape. The contaminated area will be defined by the 1,000 μg Pu^{239}/m^2 perimeter unless



CROSS-HATCHED AREA - MAGENTA
BACKGROUND - YELLOW

Figure 1. Radiological hazard marker.

the 10 mrad/hr contour line covers a larger area; personnel, animals, and equipment being moved from the area will be monitored and, when necessary, decontaminated. While the monitors are marking the area, the team leader may utilize local military or volunteer civilian personnel to operate a temporary decontamination station. After the contaminated area is marked, the team leader will report to the AAR for further instructions. If alpha or significant beta-gamma contamination is encountered, a Plucon team will be requested. Upon arrival of the Plucon team, the Alpha team may assist the Plucon team upon direction by the AAR.

40. Plucon Team Survey

The Plucon team will perform a detailed survey of the area around the accident site to include monitoring for hot spots of contamination outside the exclusion perimeter. Three methods for performing this survey are described below. The method most commonly used is the "in-an-out" method. The situation may require use of one of the other methods or an improvised method.

a. "In-and-out" Method. The area to be monitored will be divided into four sectors and a monitoring team will be assigned to each sector. The monitors will then proceed into the accident area and monitor until a turnback reading of 3,500 μg Pu^{239}/m^2 or 10 rad/hr beta-gamma is encountered. The monitors will then proceed out of the area at a different angle until the 1,000 μg Pu^{239}/m^2 level is encountered. The data that the monitors must record and report are the contamination levels (μg Pu^{239}/m^2 or mrad/hr) and the time and location at which readings were taken.

b. Isodose Rate or Isodeposit Line Method. The area will be divided into four sectors and teams will monitor for a given isodose rate or isodeposit line and define that line in their sectors. They may monitor for the 2,000, 3,000, and 3,500 μg Pu^{239}/m^2 lines if so directed. The monitors will report the time and location for all specified readings taken. The isodose rate or isodeposit line method is shown in figure 3.

c. Grid Method. The area will be marked off in grids and divided into sectors. The monitors will proceed to monitor the grid line intersections in their sector. The readings and time at each location will be recorded by the monitor.

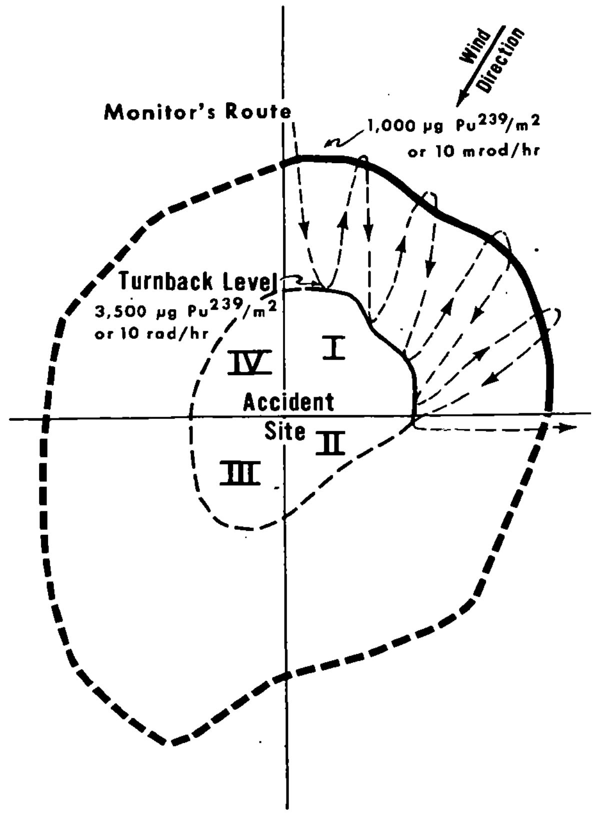
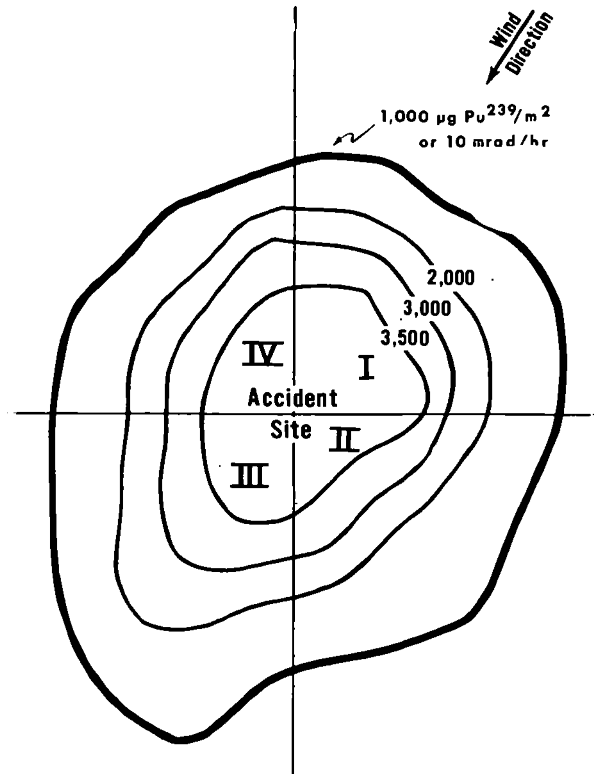


Figure 2. "In-and-out" method.



Note: Levels are preselected.

Figure 3. Isodose rate or isodeposit line method.

Reporting procedures will be outlined prior to the start of the monitoring effort. The grid method is shown in figure 4.

41. Protection for Survey Personnel

a. Alpha Team. When the Alpha team is alerted for movement to the accident site, they will report in fatigue or field clothing. Before arriving at the site, monitors will don one set of coveralls, cotton gloves, surgeon's caps, boot covers, and protective masks. All clothing openings will be sealed and sleeves will be taped to the gloves with masking tape. The collar will be turned up and sealed snugly around the neck with tape. Thus, when the monitors arrive at the accident site, they will have the minimum protection necessary to enter a contaminated area. If the accident occurs in a confined area, the initial entry team (probably EOD team) should wear some form of self-contained breathing apparatus until the total hazard has been evaluated. Upon completion of the initial survey, the monitors will report to the decontamination station to be monitored and decontaminated as required.

b. Plucon Team. When the Plucon team arrives at the accident site, each of the members will be dressed in two suits of coveralls, two pairs of boot covers, two pairs of gloves, a respirator or protective mask, and a surgeon's cap. The sleeves will overlap the gloves at the wrists and the trousers will overlap the boots at the ankles. Sleeve cuffs, boot cover tops, and openings will be sealed with masking tape. Individuals leaving the contaminated area will be monitored. The outer layer of clothing will be removed in the following order:

(1) Outer boot covers.

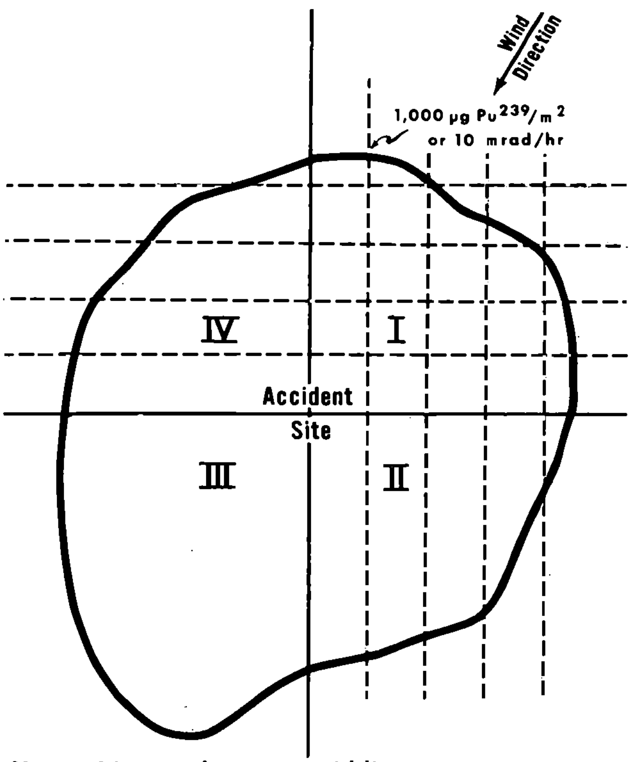
(2) Outer coveralls.

(3) Surgeon's cap.

(4) Protective mask or respirator.

(5) Outer gloves.

After being remonitored, individuals will remove the remaining clothing, perform necessary decontamination, and receive reissue of clothing as required.



Note: Distance between grid lines depends upon local factors.

Figure 4. Grid method.

42. Personnel Dosimetry

a. Exposure Control. Procedures will be established so that the total dose received by any individual during recovery operations will not exceed that specified by the AAR at the accident site. As a guide, 1.25 rad per calendar quarter from all sources of nuclear radiation is an acceptable dose. However, a larger dose may be permitted in order to save lives or recover valuable property. No individual under 18 years of age will be deliberately exposed to ionizing radiation.

b. Film Badges. Film badges will be used as the basis for the official radiation dose records for personnel involved in nuclear accident contamination control. If film badge development service is not provided with the site logistical support, the team leader of each emergency team will insure that the film badges are processed and that the results are recorded in accordance with AR 40–431 and AR 40–414.

c. Pocket Dosimeters. Pocket dosimeters will be used as exposure dose control devices at accident sites, and dosimeter readings will be used as a guide to determine personnel exposures.

d. Internal Exposure Controls. The Radiological Emergency Medical Team should be consulted regarding nose swipes and urine sample

collections which will be utilized for medical evaluation of exposed individuals.

(1) Nose swipes will be taken as early as possible on all individuals associated with the area of a nuclear accident where there is no definite information to indicate the absence of contamination and on all individuals who are known to have worked in an area of contamination.

(2) Urine samples will be collected from individuals whenever the contamination level on their nose swipes is above 200 dpm for both nostrils or where there is a suspicion of internal contamination by any mode of entry into the body. Care should be exercised not to contaminate the specimen or the container while obtaining the urine specimen.

Section IX. DECONTAMINATION

43. Principles

There are several general principles that apply to decontamination procedures.

a. The hazards of radiation cannot be destroyed except by time. Radioactive contaminants must be removed physically, and the process is similar to the removal of dirt.

b. The nature of the surface of the contaminated area or item will determine the efficiency of decontamination procedures.

c. Optimum effective decontamination will start with the simplest procedure. More complicated procedures can then be attempted so as to reduce any remaining contamination.

d. Decontamination normally will be performed from the lowest level of contamination to the highest level.

e. Decontamination of personnel will normally receive priority.

44. Methods

The three general methods of radiological decontamination are removal, sealing, and aging. For best results a combination of these methods may be necessary.

a. Removal is effective for all types of contamination and is employed in the majority of cases where time is the limiting factor.

(1) *Advantages* are that it—

(*a*) Provides, in certain cases, a relatively rapid means of decontamination.

(*b*) Permits early restoration of equipment and material.

(2) *Disadvantages* are that it—

(*a*) Require a large number of individuals.

(*b*) Requires considerable equipment and supplies.

(*c*) Produces a radioactive waste disposal problem.

b. Sealing is very effective against alpha contamination and should be used when this is the only hazard present.

(1) *Advantages* are that it—

(*a*) Provides, in certain cases, a relatively rapid and inexpensive method of decontaminations.

(*b*) Permits reuse of contaminated equipment and supplies.

(2) *Disadvantages* are that it—

(*a*) May require an extensive effort.

(*b*) Does not provide a practical means for attenuation of gamma contamination because of the quantity of material required.

(*c*) Requires periodic checks to insure that any sealing material used has not deteriorated.

c. Aging depends on the natural decay rate of the radioactive material and is very effective for short half-life emitters. It is the ideal method when time is unlimited.

(1) *Advantages* are that it—

(*a*) Does not require personnel.

(*b*) Reduces all radioactivity to some degree.

(2) *Disadvantages* are that it—

(*a*) Proves ineffective for contaminants with long half-lives because an extended period of time is required.

(*b*) Imposes limited access security measures.

(*c*) Precludes early usage of contaminated area and equipment.

45. Personnel Decontamination

a. General. If the accident site is contaminated, a personnel monitoring station should be established for personnel leaving the contaminated area. Military personnel will decontaminate themselves. Civilians contaminated will be advised to change clothing and place the contaminated clothing in a bag for decontamination. After removing contaminated clothing, they should take a shower and be remonitored. The presence of contaminated female personnel will require that separate decontamination facilities be provided.

b. Alpha Monitoring. Monitoring of individuals for alpha contamination is very slow and difficult; emergency team personnel working in contaminated areas may omit the preliminary monitoring of individuals if routine procedures require decontamination and change of clothing. In case of rain, alpha monitoring may be misleading, based on attenuation by the moisture present.

c. Monitoring. Monitoring is performed to detect contamination on the body, serve as a guide for decontamination, and prevent internal hazards.

(1) *Equipment.* The selection and correct use of proper instruments is essential. Radiacmeters equipped with separate probes are used for monitoring of personnel.

(2) *Procedures.* A complete and careful check of those parts of the body and clothing most susceptible to contamination must be made. A systematic sequence should be followed; for example, monitoring the hands first, then monitoring the face and head, and proceeding down the body to the feet.

(*a*) The use of earphones results in an easier and more accurate monitoring effort. The monitors can watch the probe so that it will not become contaminated and can hear an audible response if contamination is present.

(*b*) The probe should be held close to the surface being monitored and moved with a slow, steady motion. The distance from the surface should be 2 to 3 centimeters for beta-gamma contamination. The probe should be placed directly on the surface for alpha contamination.

(*c*) Personnel being monitored should stand on a pad or platform located on the contaminated side of an arbitrary line drawn in the area. The person should be instructed to stand with feet spread apart about 30 centimeters (approximately 1 foot) and arms extended sideward with palms up and fingers straight.

(*d*) Steps to be followed are listed below:

1. Monitor both hands and forearms with palms up; repeat with hands and arms turned over.

2. Monitor the entire front of the body, starting at the top of the head. Check the forehead, nose, mouth, neckline, torso, knees, and ankles thoroughly. Have the person turn around; repeat the procedure from head to ankles.

3. Have the person raise one foot; then monitor the sole. Repeat the procedure for the other foot.

(*e*) Wounded personnel should be monitored under the supervision of, or by, medical personnel.

(*f*) If contamination is found in excess of prescribed permissible limits as indicated in table IV, decontamination will be required. If no contamination is found, no further action is required except that if the water supply is not critical, personnel should be required to wash or shower.

d. Decontamination in the Field.

(1) Establishment of a temporary decontamination station may be necessary. If so, it should be located where entry into and exit from the contaminated

area takes place. This station should include—

(a) Containers for waste material.

(b) Containers for contaminated clothing.

(c) Swabs and masking tape for removing hot spots.

(d) Containers of soapy water.

(e) Containers of rinse water.

(f) Towels and supply of clothing.

(g) Radiac instruments.

(2) Persons coming from the contaminated area will be initially monitored. They will then remove outer clothing consisting of boot covers, gloves, respirator, coveralls, and surgeon's caps. Any hot spots will be cleaned with swabs or masking tape to reduce spread of contamination.

(3) After washing with soapy water and rinsing, individuals must be thoroughly dry before being remonitored since water will shield alpha particles.

e. Detailed Procedures. If decontamination is not fully effective, the following techniques will be used for each specific area:

(1) *Body and skin.*

(a) Spot clean hot spots, using swabs and masking tape. Remonitor to determine effectiveness.

(b) Wash the entire body, hair, and hands, using soapy lather and plenty of hot water. Clean fingernails.

(c) If soap lather is not effective, use the following materials which can normally be procured from local sources or the nearest medical facility.

1. A water paste mixture of 50 percent powdered detergent and 50 percent cornmeal. Massage with this for 5 minutes and then rinse thoroughly with water.

2. A 5-percent water solution of a mixture of 30 percent detergent, 65 percent Calgon or other water softener, and 5 percent Carbose (carboxylmethyl cellulose). Rub vigorously for 1 minute and then rinse thoroughly with water.

3. A preparation consisting of 8 percent Carbose, 3 percent detergent, 1 percent Versene, and 88 percent water homogenized into a cream. Apply as a skin cleanser without water and then wipe off.

4. Waterless cleanser used by automobile mechanics.

5. Commercial cleansing creams.

(2) *Hands.* Use soap lather and rinse. Clean fingernails. If contamination still remains after two attempts, apply mixtures listed in (1) (c) above as required. In some cases, wearing surgeon's rubber gloves for a period of approximately 30 minutes will cause sufficient sweating to remove contamination.

(3) *Hair.*

(a) Wash hair several times. Repeat until decontamination has been effected or until further washings will obviously be ineffective.

(b) If contamination is not lowered to acceptable levels, shave the head and apply skin decontamination methods to the scalp.

(4) *Wounds.* Wounds will be treated by such first-aid measures as appropriate without consideration of contamination. If alpha contamination is found on other parts of the body when monitored, assume that wounds are alpha contaminated; after first aid, refer the casualty to medical personnel to determine the appropriate priority of action.

f. Evaluation. Upon completion of decontamination procedures, personnel should be monitored again to insure that permissible levels shown in table IV are not exceeded. If permissible levels are still exceeded, medical assistance should be requested. Any surface being monitored for the presence of alpha contamination must be completely dry because water will shield residual contamination.

46. Clothing and Launderable Equipment Decontamination

a. Launderable equipment items can be placed in an automatic washing machine and

laundered without damage to the equipment or the washing machine.

b. Those items that are contaminated above permissible levels and that do not show any appreciable contamination reduction after three successive launderings should be disposed of as radioactive waste. Exceptions may be made if decay is likely to reduce the contaminants to acceptable levels (table IV) within a reasonable time and if security and storage requirements are economically feasible.

c. Automatic washing machines should be clean and free of soap scum to prevent deposition of contamination. If decontaminating agents (see TM 3–220 and *d* below) are used, they will aid in keeping washers free of contamination.

d. Laundering involves seven operations of 5 minutes each, using hot water (120° to 140° F.) and additives as indicated below:

(1) First wash—detergent.

(2) Second and third washes—citric acid.

(3) Fourth and fifth washes—chelating agent such as Versene.

(4) Sixth and seventh washes—water rinses.

e. After the decontaminated items have been laundered and completely dried, they must be checked for any remaining contamination.

47. Equipment Decontamination

a. If the removal method of decontamination is attempted on items that are contaminated to high beta-gamma levels, it may result in excessive personnel exposures. Natural decay may reduce this contamination to reasonable working levels.

b. The sealing method will not be normally used except for alpha contamination; it should be used only after removal methods have not been adequate.

c. Five general methods by which surface contamination may be removed or reduced are as follows:

(1) Brushing or vacuum cleaning.

(2) Washing, soaking, or scrubbing with hot or cold water. Soap, detergents, or chelating agents may be used.

(3) Steam cleaning.

(4) Cleaning with solvents.

(5) Removing surface by using chemicals, abrasives, sandblasting, grinding, or electrolysis. (Care must be exercised to preclude inhalation of contaminated residue.)

For details on employing these methods, see TM 3–220.

d. The simplest removal methods will be tried first and then followed by the more difficult methods. Each method will be tried at least twice before a different method is used.

e. After an item has been monitored, an appropriate decontamination method will be selected and the necessary steps performed; then the results will be evaluated by remonitoring. This procedure will be repeated until the contamination is within permissible levels. The following details for specific items are furnished:

(1) *Vehicles.*

(*a*) If vehicles are required within a contaminated area, consideration should be given to using the same vehicles and keeping them in the contaminated area until completion of recovery operations. This will reduce the decontamination workload and the replacement costs.

(*b*) The highest levels of contamination will usually be under fenders, on the undercarriage where lubricants are exposed, on wheels and tires, and inside where tracked into a vehicle. When liquids are used for decontaminating, procedures should be started at the top.

(*c*) Weather-cracked tires are difficult to decontaminate. Disposal of contaminated tires may be necessary.

(2) *Radiacmeters.*

(*a*) A low level of contamination can be allowed when instruments are being used in monitoring for high levels of contamination. The initial reading is noted and subtracted from any subsequent readings.

(*b*) Contamination of the instrument may be determined by removing it from the contaminated area and

checking the reading. Any reading above normal background indicates contamination of the instrument. Alpha instrument contamination can be determined within an alpha-contaminated area by holding the sensitive detecting probe 30 centimeters (approximately 1 foot) or more away from all surfaces and noting the meter reading. The meter needle should indicate zero, and only background clicks should be heard with the headset if the instrument is not contaminated.

(*c*) Extreme care is necessary to avoid damaging the shields or probe windows when decontaminating alpha instruments. Most radiacmeters can be decontaminated by wiping the exterior surfaces with a damp cloth or sponge. Contamination can also be removed by running water under low pressure over the surface. Care must be taken to prevent water from getting inside the probe where it can short out the electronic circuits. With gas flow devices, operating the gas flow valve in the FLUSH position will help to keep the water being used out of the probe. A less effective means of decontamination is to wipe the probe gently with clean cotton or a camel's hair brush. The sticky surface or masking tape provides an effective means of decontaminating the instrument probe. If the probe cannot be decontaminated using these methods, the probe face should be changed.

(3) *Miscellaneous items.*

(*a*) Moistureproof protective clothing, rubber boots, and similar items can usually be effectively decontaminated by showering, washing, or hosing prior to removal.

(*b*) Canvas, rope, and similar coarse materials readily absorb contaminants which have a tendency to imbed deeper into the materials when liquids are used. Dry brushing or vacuum cleaning is the most suitable technique for such materials. If these procedures prove ineffective, these items may be allowed to age or may be disposed of if alpha or other long-lived emitters are involved.

f. When items are washed, soaked, or scrubbed with liquids other than water or with liquids containing soap, detergents, or solvents, clear water will be used as a final rinse.

48. Area Decontamination

Specific methods of area decontamination will be dictated by the type of surface to be decontaminated and the type of emitter. For alpha decontamination, first remove the gross contaminant by use of brooms or shovels and deposit in appropriate containers. The best type of container is a tin can with a pressure snap lid that can be placed into a slightly larger tin can with a similar lid, thus providing a double-walled container. Cleanup after the gross contaminant is removed is best performed on all dry surfaces, except vegetation, by use of a vacuum cleaner. Contaminated grass, grains, small shrubbery, and berry foliage should be cut close to the ground and removed; the cut area should be decontaminated again by a vacuum apparatus. Beta-gamma contamination indicates the presence of fission products whose multiple decay is very rapid with time immediately after the accident. Aging should be the primary method for decontamination for as many days after the accident as is possible. If, or when, removal procedures must be used for decontamination to safe levels, the contaminated surface again will dictate the procedure to be used. For details of such area decontamination, see TM 3–220 and TM 3–225.

49. Permissible Levels

a. Any radiological contamination should be reduced to the lowest level possible by decontamination procedures. These methods will usually result in a reduction and not in complete removal of residual contamination.

b. Permissible levels of contamination for various surfaces are given in table IV.

Table IV. Permissible Contamination Levels.

Surface[1, 2]	Beta-gamma (mrad/hr)	Alpha (cpm/cm²)
Nose swipes[2]	--	1.0
Skin[3]	1.0	7.5
Clothing	1.0	7.5
Shoes:		
Outside	5.0	7.5
Inside	1.0	7.5
Respirators	1.0	7.5
Equipment (for use in contaminated area)	1.0	7.5
Vehicle[4] (for Government use)	1.0	7.5

[1] Fixed: no detectable activity on swipe test (except nose swipes).
[2] See TM 3-260 for swipe procedure.
[3] All contaminated wounds will be treated by medical personnel.
[4] No detectable activity if vehicles are for public use.

Section X. CONTROL OF A NUCLEAR ACCIDENT SITE

50. General

Immediate military control of a nuclear accident site will be established by the nearest military commander (par. 3*a*) pending arrival of the Army Area Representative. Control requirements will vary according to the magnitude of effects from the nuclear accident. Commanders of troop units should comply with the procedures stipulated herein to the extent commensurate with their capabilities prior to arrival of trained specialists. Some emergency actions may be performed by civilian personnel pending arrival of emergency forces from military installations. These actions may include—

a. Rescue, first aid, and evacuation of injured personnel.

b. Fire fighting to prevent further personnel injury.

c. Notification of the nearest military installation and appropriate civilian agencies.

51. Control Measures

Upon arrival at the scene of the accident, the AAR or the commander of the nearest military installation or his representative will establish a control point to coordinate all activities directed toward control of the area. Measures required for control of the hazardous area include those for control of personnel and for control of contamination.

a. Area Control. The size and shape of any area requiring control measures will depend upon the nature of the accident and upon meteorological and terrain conditions. Pending detection of alpha contamination or measurement of significant beta-gamma contamination, the following guides will be used to mark the area:

(1) Coordinate with ordnance personnel to ascertain the area of hazard from blast effects of a nonnuclear detonation. This area can be used for initial contamination control prior to actual monitoring. However, in the event that EOD personnel have not arrived at the site, this area will not be less than 550 meters in radius.

(2) Extend the initial area downwind to the following recommended minimum distances (pending determination of the actual extent of the radiation hazard) for varying ambient surface wind velocities:

Wind velocity *mph*	Wind velocity *knots*	Downwind distance *meters*
6–10	4–9	1,050
11–15	10–13	1,550
16–20	14–17	2,050
Above 20	Above 17	2,550

(3) Since the contamination may extend for considerable distances, the area that must be evacuated will be determined by the AAR after evaluating monitoring and survey reports. Personnel and animals should be evacu-

ated from the area suspected of contamination as expeditiously as possible.

b. Personnel Control. Personnel in support of the control and recovery activities will be distinctively identified to facilitate control and to expedite recovery operations.

(1) *Control center.* To minimize exposure to personnel, a control center will be established near but upwind and outside the contaminated area. The control point established by the AAR or the military commander may become this control center if it is outside the contaminated area.

(2) *Control stations.* Entry and exist points to the contaminated area will be limited to the number absolutely necessary for control and recovery of the area. Those persons not associated with emergency operations should remain outside the contaminated area. Military police, if available, should be utilized to enforce personnel control measures prescribed by the AAR or the military commander in charge. If and accident occurs on other than military installations, employment of military police must be in conjunction with civilian law enforcement agencies (AR 360–5). Records of entry and exist times will be maintained.

c. Contamination Control. Every effort should be exerted to contain the contamination within a localized area.

(1) Personnel leaving and animals and equipment being removed from any contaminated area will be monitored at the control station to minimize spread of contamination. Movement within a contaminated area should be reduced to a minimum.

(2) Controls will be established so that the total dose from all sources of nuclear radiation received by any individual will not exceed the dose established by Part 20, Title 10, Code of Federal Regulations. A film badge and two self-reading dosimeters will be worn by all personnel entering the area. Procedures will be established to prevent the inhalation and ingestion of radioactive particles. For the purpose of rescuing injured personnel, these requirements may be waived in emergencies.

(3) Decontamination stations should be located at the exist points adjacent to the control stations so that decontamination can be supervised by the Alpha team or the Plucon team.

(4) Radioactive waste should be controlled and placed in temporary storage pending receipt of final disposition instructions from Commanding General, Edgewood Arsenal, Maryland. Whenever possible, contamination at safe levels should be fixed permanently to preclude resuspension (sec. XI).

(5) Air sampling stations should be established downwind to determine possible airborne concentration of radioactivity.

Section XI. RADIOACTIVE WASTE DISPOSAL

52. General

Radioactive waste includes any material which is radioactive or which is contaminated with radioactive material and which is no longer of use to the processing agency.

53. Classification of Radioactive Waste

One method of classifying radioactive waste is by physical form.

a. Solid Waste. Solid waste includes such material as contaminated equipment and contaminated trash (to include surface layer of ground contaminated from a nuclear accident).

b. Liquid Waste. Liquid waste will usually be of low level contamination and may be produced in large amounts from decontamination operations and some laboratory operations. With proper dilution as outlined in Title 10,

Code of Federal Regulations, Part 20, liquid contamination may be disposed of in a sewerage system.

c. Gaseous Waste. Gaseous waste normally will not require decontamination and disposal as it will be diluted by dispersion in the air.

54. Responsibilities

a. The Surgeon General is responsible for prescribed conditions under which local disposal of radioactive waste material is authorized.

b. The Commanding General, Edgewood Arsenal, is responsible for exercising staff supervision over all matters pertaining to the disposal of radioactive material within the Department of the Army.

c. Installation and activity commanders having radioactive material for disposal are responsible for providing adequate security, storage, and monitoring services. For detailed instructions, refer to AR 755–380, TM 3–220, TM 3–225, and TM 3–260.

55. Instructions for Packaging, Labeling, and Shipping of Radioactive Waste

a. Packaging Instructions.

(1) Returnable amounts of source and special (SS) nuclear material from special weapons will be packaged, labeled, and shipped in accordance with instructions in TM 39–20–6.

(2) Radioactive waste such as paper, clothing, and dirt contaminated from a nuclear accident will be packaged, labeled, and shipped to a radioactive material disposal facility for ultimate disposal. The radioactive waste will normally consist of large amounts of dirt and other material and will be packaged in accordance with Interstate Commerce Commission (ICC) (Title 49, Code of Federal Regulations, Parts 71 and 78) regulations so far as possible. If ICC regulations cannot be complied with, application should be made to the Commanding General, Edgewood Arsenal, Maryland, for special permit and provisions of escort.

(*a*) Radioactive materials that present special hazards due to their tendency to remain fixed in the human body for long periods of time (radium, plutonium, strontium, etc.) must be packed inside metal containers in addition to the packing prescribed below.

(*b*) The design and preparation of the package must be such that there will be no significant radioactive surface contamination of any part of the container.

(*c*) All outside shipping containers must be of such design that beta-gamma radiation will not exceed 200 mrad/hr at any point of readily accessible surface. Containers may be equipped with handling devices when necessary.

(*d*) To meet the above requirements, 55-gallon drums or garbage cans may be used if provision is made for sealing the containers prior to shipment for ultimate disposal. One method of sealing is to place a layer of concrete inside the can or drum. This may be done by using a mold in which to pour concrete. The concrete should be from 1 to 2 inches thick on the top, bottom, and sides of the container. The concrete will probably provide enough shielding to reduce the contamination level on the container surface below 200 mrad/hr.

b. Labeling Instructions. When radioactive material is shipped by common carrier, labeling will conform to the ICC regulations. In addition, labeling will conform to the provisions of AR 755–380.

c. Shipping Instructions. Shipping instructions will be requested from Commanding General, Edgewood Arsenal, ATTN: Depot Operation Division, Edgewood Arsenal, Maryland.

APPENDIX I

REFERENCES

1. Department of the Army Publications

AR 15–22	Nuclear Weapon Accident Investigation Board (CONUS)
AR 40–414	Noncombat Personnel Dosimetry
AR 40–431	Record of Exposure to Ionizing Radiation
AR 40–582	Evaluating and Reporting Internal Exposure to Radioactive Materials
(C) AR 55–203	Movements of Nuclear Weapons Major Assemblies and Nuclear Components (U).
(O) AR 95–55	Nuclear Weapon Jettison (U)
(C) AR 190–60	Physical Security of Atomic Weapons (U)
AR 220–58	Organization and Training for Chemical, Biological, and Radiological Operations.
AR 320–5	Dictionary of United States Army Terms
AR 320–50	Authorized Abbreviations and Brevity Codes
AR 360–5	Public Information, General Policies
AR 360–80	Release of Information When More than One Service is Involved in Accidents or Incidents.
AR 385–30	Safety Color Code Markings and Signs
AR 580–15	Security Requirements for Nuclear Weapons
AR 700–52	Licensing and Control of Radioactive Materials
(O) AR 700–65	Nuclear Weapons and Nuclear Weapons Materiel (U)
AR 755–14	Responsibilities for Explosive Ordnance Disposal
AR 755–380	Disposal of Unwanted Radioactive Material
FM 3–12	Operational Aspects of Radiological Defense
TM 3–210	Fallout Prediction
TM 3–220	Chemical, Biological, and Radiological (CBR) Decontamination
TM 3–225	Radiological Recovery of Fixed Military Installations
TM 3–260	Operation of Radioactive Material Disposal Facilities
TM 5–315	Fire Protection by Troop Organizations in Theaters of Operations
TM 9–1903	Care, Handling, Preservation, and Destruction of Ammunition
TM 11–6660–205–15P	Repair Parts and Special Tools List and Maintenance Allocation Chart: Anemometers ML–433/PM and ML–433A/PM.
TM 11–6665–207–12	Operation and Organizational Maintenance: Radiac Set AN/PDR–53
TM 11–6665–208–15	Operator's, Organizational Field and Depot Maintenance: Radiac Set AN/PDR–54.
TM 11–6665–209–15	Operator, Organizational, Field and Depot Maintenance Manual: Radiac Set AN/PDR–27J.
TM 11–6665–213–12	Operator and Organizational Maintenance Manual: Radiacmeter IM–174/PD.
TM 11–6665–214–10	Operator's Manual: Radiacmeters IM–93/UD, IM–93A/UD, and IM–147/PD.

(C) TM 39–20–6	Disposal of Radiocative Waste (U)
TC 101–3	Nuclear Radiation Terminology
TC CML 77	Calibrator, Radiac, TS–1230A/PD
TM CML 79	Water Testing Kit, Poisons, M4A1
TB MED 254	Permissible Dose from External Sources of Ionizing Radiation
TB SIG 226–4	Radiacmeter IM–9B/PD
TB SIG 226–8	Chargers, Radiac Detector PP–1578/PD and PP–1578A/PD.
TB SIG 226–9	Field Expedient for Charging Radiacmeters IM–93/UD and IM–147/PD
TB 385–2	Nuclear Weapon Fire-Fighting Procedures
SB 11–206	Film Badge (Photodosimetry) Supply and Service for Technical Radiation Exposure Control.
TA 20–11	Individual Safety and Protective Clothing and Equipment

2. Defense Atomic Support Agency (Formerly AFSWP) Publications

(S) Technical Letter 20–2, Hazards Associated with Accidents Involving Special Weapons (U), 15 April 1959.

3. Other Publications

a. These publications are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

(1) Handbook of Federal Regulations, Transportation of Radioactive Materials, May 1958.

(2) Code of Federal Regulations, Title 10, Part 20, Standards for Protection Against Radiation.

(3) Code of Federal Regulations, Title 49, Parts 71 and 78, Packaging, Labeling, and Transportation of Dangerous Articles.

(4) National Bureau of Standards (NBS) Handbooks:

(*a*) No. 51, Radiological Monitoring Methods and Instruments.

(*b*) No. 65, Safe Handling of Bodies Containing Radioactive Isotopes.

(*c*) No. 69, Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.

(5) Joint Department of the Army, Navy, Air Force, and Atomic Energy Commission Agreement of General Areas of Responsibility and Procedures Applicable to the Prompt, Effective, and Coordinated Response to Accidents Involving Nuclear Weapons, 27 February 1958.

b. This manual is published by the Eberline Instrument Corporation, Santa Fe, New Mexico: Technical Manual for Scintillation Alpha Counter; Model PAC–1SA.

APPENDIX II

SAMPLE SOP OUTLINE

(Classification)

Headquarters
Location
Date

ANNEX______(ALPHA TEAM) TO NUCLEAR ACCIDENT CONTAMINATION CONTROL SOP

1. GENERAL

The purpose of this annex is to standardize normal procedures for minimizing the possible hazardous effects of radioactive contamination due to a nuclear accident and to effect expeditious decontamination of an accident site if required.

2. REFERENCES

FM 3–15, Nuclear Accident Contamination Control.

Appendix 5 (Nuclear Accident/ Incident Control (NAICP)) to Annex F, USCONARC–BP or appropriate army area basic plan.

3. DEFINITIONS

a. Standby team—status when the team leader is notified that a weapons shipment is in progress.

b. Alerted team—status when the team leader is notified that an accident has occurred.

c. Army Area Representative (AAR)—a designated senior officer who, by knowledge and experience, is capable of making rapid and vital decisions and recommendations necessary to prevent or minimize the hazardous effects that can result from a nuclear accident.

d. Alpha team—a radiological team with a primary alpha monitoring and a secondary beta-gamma monitoring mission. The team is also capable of limited personnel decontamination.

e. Plucon team—plutonium monitoring and decontamination team.

4. DUTIES AND RESPONSIBILITIES

a. Team leader will:

(1) Prepare and maintain up-to-date informational roster of all team members.

(2) Insure that each team member is aware of his assigned duties and is properly trained.

(Classification)

(3) Prepare a checklist to insure that the team on alert status can assemble, load equipment, and prepare to move out within 30 minutes during duty hours and within 1 hour during off-duty hours.

(4) Inform the AAR on the nature of the hazard upon arrival at the accident site and assist in controlling the spread of contamination.

b. Assistant team leader will assist the team leader and assume control if necessary.

c. Monitors will be capable of performing alpha and beta-gamma monitoring and survey procedures.

d. Each team member will be trained in his assigned duties as well as the duties of all other members so in the event one member is unable to participate for any reason, any other member is sufficiently trained to perform his duties.

5. WARNING SYSTEM

The Alpha team will be notified to "stand by" when the movement of a nuclear weapon is scheduled. In the event of an accident, this team will be "alerted" for movement.

6. CAPABILITIES

The Alpha Team will be capable of:

a. Performing alpha and beta-gamma radiation monitoring.

b. Performing alpha and beta-gamma radiation surveys.

c. Supervising personnel and equipment decontamination.

d. Providing guidance to the AAR on contamination control.

e. Assisting the Plucon team as required.

7. PROCEDURES

The Alpha team will determine the presence or absence of radiological contamination. This determination must be made regardless of accident type.

a. Locate and mark the approximate perimeter of the contaminated area, using the following conditions as a guide for establishing the extent of the area:

(1) If significant beta-gamma radiation is present, mark the general location of the 10 mrad/hr dose-rate contour line.

(2) If plutonium contamination is the dominant hazard, mark the general location of the 1,000 μg Pu^{239}/m^2 isodeposit line.

(3) If both alpha and gamma radiation are detected, the exclusion perimeter may be a combination of contours determined as (1) and (2) above, using the contour farthest from zero point of the accident.

b. Film badges and pocket dosimeters will be utilized at the accident site to control exposures to beta-gamma radiation.

c. Control will be established so that the total dose received by any individual exposed during recovery operations will not exceed 1.25 rad per calendar quarter from all sources of nuclear radiation. However, a larger dose may be permitted in order to save lives or recover valuable property.

d. After operating at the site of a nuclear accident, persons will report to their servicing medical facility for evaluation of possible internal radiological contamination as required by AR 40–582.

8. PROTECTION

Personnel engaged in the initial area monitoring will wear respiratory protection, coveralls, gloves, surgeon's cap, and boot covers until the radiological contamination situation has been determined.

9. DECONTAMINATION

Only expedient emergency-type personnel decontamination will be performed unless directed by the AAR.

a. Personnel. Contamination should be kept as low as possible. Persons leaving the contaminated area will be monitored; decontamination will be required whenever contamination is found on skin or clothing.

(1) Members of the military services will be required to decontaminate themselves.

(2) Civilians who are contaminated will be advised to remove clothing and place the contaminated clothing in a bag for decontamination. They should then shower and return for further monitoring. If no contamination is found, they should put on clean clothing.

b. Equipment. Vehicle and other equipment contamination must be reduced to less than 1.0 mrad/hr (beta-gamma) and 7.5 cpm/cm^2 (alpha) fixed. Respiratory protective devices will not be used if the contamination level of these devices is greater than 1.0 mrad/hr (beta-gamma) or 7.5 cpm/cm^2 (alpha).

c. Area and Buildings. The Plucon team will supervise necessary decontamination.

10. SUPPLY

The Alpha team will be equipped to perform its mission and will be provided necessary protective clothing and equipment in accordance with TA 20–11.

11. TRAINING

All team members will be trained in alpha and beta-gamma monitoring.

a. Cross-training and periodic training in depth will be conducted to insure capability for performance of the team's mission.

b. Periodic practice alerts will be conducted to maintain readiness. These tests will consist of assembling the team and its equipment, moving to the site of a simulated accident, and conducting a survey.

12. RECORDS AND REPORTS

Operational and administrative records will be maintained and reports will be submitted as required. Area maps and overlays will be kept current and the chronological sequence of events will be logged.

OFFICIAL: Command Line

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

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COA (1)
CINFO (1)
TIG (1)
TJAG (1)
CNGB (2)
TSG (2)
TPMG (2)
USCONARC (5)
USACDC (2)
USACBRCDA (5)
ARADCOM (2)
ARADCOM Rgn (2)
LOGCOMD (1)
MDW (2)
Armies (5) except
  Third US Army (85)
Corps (3)
Div (2)
Div Arty (1)
Bde (1)
Regt/Gp/Bg (1)
CC (1)
Bn (1)
Co/Btry (1)
Svc Colleges (2)
Br Svc Sch (2) except
  USA Ord Cen & Sch (25)
  USASCS (50)
  PMGS (5)
  USAES (10)
  USATSCH (150)
  MFSS (30)
AFSC (2)
USA Nuclear Def Lab (2)
USA CBR Wpn Orien Cen, Dugway PG (2)

NG: State AG (3); units—same as Active Army except allowance is one copy to each unit.

USAR: Units—same as Active Army except allowance is one copy to each unit.

For explanation of abbreviations used, see AR 320-50.

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